MinMountaintop Mining/Valley Fill Environmental Impact Statement Technical Study

WORK PLAN APPROACH FOR FISHERIES

November 1999

I. Problem Statement

A typical mountaintop mining/valley fill (MTM/VF) operation in the Appalachian coalfields removes overburden and interburden material to facilitate the extraction of low-sulfur coal seams, and requires placement of excess spoil into valleys containing first and second order streams. Because there is little historical information regarding stream fish populations in the primary region of MTM/VF mining, this work plan proposes to 1) characterize the fish communities that exist in this region; 2) determine if any unique fish populations exist in this area; and 3) evaluate the effects of MTM/VF operations on fish populations residing in downstream areas.

II. Goals and Questions to be Addressed by this Work Plan

The steering committee for the Environmental Impact Statement (EIS) has adopted goals and questions to be addressed from several different perspectives: environmental, regulatory, and public service. This work plan, in conjunction with the other work plans and technical symposia that will be conducted during the preparation of the EIS, will attempt to address the following goals as adopted by the committee:

- To determine the impact on environmental resources (including aquatic resources) from the size and location of excess spoil disposal in valley fills associated with mountaintop mining operations,

- To show... how such mining operations might be carried out in a way that minimizes adverse impacts to streams and other environmental resources, and

- To examine how to improve environmental assessment and design of individual mining projects.

Similarly, this work plan will attempt to answer the following questions posed by the EIS steering committee:

- How will we measure the effects (impacts) of mountaintop mining operations and associated valley fills on streams and aquatic life?

- What are the most appropriate qualitative and quantitative measures of effectiveness of stream restoration?

- What are the short- and long-term effects of individual mountaintop mining operations and associated valley fills on the physical, chemical and biological conditions of affected streams and their watersheds, both within the area of direct impact and downstream? In answering this, consider water quality and quantity, changes in aquatic habitat, and stream use.

- What are the expected effects likely to be on aquatic species of federal and state concern (i.e., listed and proposed threatened and endangered species, candidate species, and species of special concern?

- What are the relative individual and cumulative effects of a single large valley fill versus multiple small headwater fills? In answering this question, assess the relative value of headwaters and their contribution to the physical, chemical and biological health of the larger watershed.

- How do we reach a better scientific consensus on the water quality/aquatic habitat values of valley headwater streams so that the on-site impacts of fills, and the resulting mitigation, restoration and reclamation requirements can be judged more effectively -- both in the fill area and downstream? What does "minimize" environmental damages mean in this context?

- How do we evaluate and improve stream restoration practices so that ecological health and viability are returned to waters on mined landscapes; how quickly can ecological restoration be achieved; what is the extent and nature of irreversible loss of stream habitat from mining?

- How effective have the reclamation practices and compensatory mitigation measures required to date for mountaintop removal and other mountaintop mining operations, and for valley filling, been in offsetting the adverse effects of such activities on aquatic environments? What have been the frequency, results, and effectiveness of follow-up compliance monitoring?

- After evaluating the combined effects of mining and other surface disturbing activities, and the offsetting effects of reclamation and compensatory mitigation, what are the expected net cumulative effects of existing, ongoing, and all viable future mountaintop mining operations on the aquatic environments of the Appalachian coalfields region? What impacts will the future projects have on environmental resources, including waters of the U.S. and fish and wildlife?

- What environmental analyses should be required before a mining plan is submitted? During mining? After mining and reclamation end?

- What criteria should be used to determine whether a fill may be placed in a stream.

- To what degree are the drainage control measures being established on fills able to replace aquatic habitats that existed prior to construction of the fill, and can designs be modified to further enhance or accomplish this?

- Regarding the effectiveness of existing forms of mitigation associated with valley fills in replacing or providing substitute resources, can existing forms of mitigation be modified to further enhance or accomplish this?

- What is a stream? The agencies should develop a mutually acceptable approach for reconciling the interagency and interstate differences concerning the definition of streams.

III. EIS Team Members and Experts Consulted

Point of Contact: Cindy Tibbott, U.S. Fish and Wildlife Service, Suite 322, 315 South Allen Street, State College, PA 16801, (814) 234-4090, cindy_tibbott@fws.gov

EPA Wheeling Office: Jim Green, Maggie Passmore
FWS: Dan Ramsey
WVDNR: Walter Kordek, Michael Hoeft, Dan Cincotta

Experts Consulted: Drs. Jay Stauffer and Paola C. Ferreri, the Pennsylvania State University; and Dr. Frank Borsuk, Potesta & Associates

IV. Study Approach

The fisheries portion of the EIS will be conducted entirely through a contract between the U.S. Fish and Wildlife Service and the Pennsylvania State University (PSU). PSU's Dr. Jay Stauffer, author of *The Fishes of West Virginia*, will complete a study entitled "A Survey of Stream Fish Populations in the Primary Region of Mountaintop Removal/Valley Fill Coal Mining." Dr. Stauffer's detailed study plan is presented in Section VI in its entirety. To the extent practicable, Dr. Stauffer will use the same stream sampling locations used for benthic invertebrate studies in the "Work Plan Approach for Streams" portion of the EIS, as well as other sampling locations in the same watersheds.

V. Projected Study Costs

The cost of this study is $193,705. Funding for all but approximately $50,000 of this total has been secured.

VI. Detailed Study Plan

INTRODUCTION

The State of West Virginia encompasses 62,890 km^2, of which 79% are forested, 12% are devoted to agriculture, 6% are developed, 2% are used in mining, and 1% is wetland. There are approximately 9,000 streams with a combined length of more than 45,000 km. The major

drainages include the Ohio, Big Sandy/Tug Fork, Kanawha, Little Kanawha, and Monongahela rivers of the Mississippi River basin, and the Potomac and James rivers of the Atlantic Slope. A total of 176 fish species distributed among 22 families are known from West Virginia (Stauffer et al. 1995).

The U.S. Environmental Protection Agency, U.S. Office of Surface Mining, U.S. Army Corps of Engineers, U. S. Fish and Wildlife Service, and the West Virginia Division of Environmental Protection have been charged with the responsibility to complete an environmental impact statement for mountain top mining and the associated valley fill that is currently being used in West Virginia. To this end, they have developed a series of protocols to sample macroinvertebrates at approximately 37 sites in West Virginia. These sampling sites were selected based on historical, current, and proposed sites of mining and, where possible, were grouped so that the both affected and reference sites are sampled within a given drainage. Because there is little historical information regarding stream fish populations in the primary region of mountain top removal/valley fill coal mining, the U. S. Fish and Wildlife Service requested that we submit a proposal to sample the fish communities at each of the pre-selected benthic invertebrate sample sites, and at additional locations within the same watersheds. The objectives of this study are to 1) characterize the fish communities that exist in the primary region of mountain to removal/valley fill coal mining, 2) determine if any unique fish populations exist in this area, and 3) evaluate the effects of these mining operations on fish populations residing in downstream areas.

SCOPE OF WORK

Characterization of Fish Communities

Fish communities will be sampled in sites designated and attributed by the U.S. Environmental Protection Agency. These include the existing benthic macroinvertebrate sampling sites. At each site, population estimates of each species will be made using the removal method of Van Deventer and Platts (1983). Depending on the site, a stream section at least 40 times the stream width and not to exceed 150m will be selected (Lyons 1992). Each stream segment location will be recorded using a GPS unit to ensure accurate description of the collection site and to allow future collections to occur in the same reach. Sampling will begin in fall 1999 and continue in April and May, 2000.

Fishes will be collected at each site using a backpack electrofishing unit and/or seines. Collections will begin at the most downstream end of the section and proceed upstream for the entire section. All fishes from the first pass will be placed in a bucket labeled "Collection #1." Two additional collections will be made in a similar fashion, and fishes placed in buckets labeled "Collection #2" and "Collection #3." The numbers of fish collected during each subsequent pass should decline; in the event that this does not occur, additional passes may need to be conducted. Each collection will be preserved separately and brought back to the lab for further analysis. Fishes collected in each of the three passes will be identified and counted separately. The three separate counts for each species will then be used in the BASIC program, MicroFish (van Deventer and Platts 1983)

to estimate population size. Values obtained will be converted to number of individuals/m^2. In addition, preserved specimens will be weighed (g) to determine standing crop at each site.

The majority of fishes will be preserved in 10% formalin and transferred to The Pennsylvania State University Fish Museum for permanent storage in 50% isopropanol. If brook trout (*Salvelinus fontinalis*) are collected, the adipose fin of all trout collected will be clipped and placed in 100% ethanol. Brook trout will be counted, measured (total length, mm), weighed (g), and released. Only 10 brook trout from each collection will be preserved. In addition, where sculpins, *Cottus* spp., are collected, 10 will be frozen on dry ice and transported to the ultra-freezer at Penn State. Dr. R. Raesly, a former Ph.D. student of J. R. Stauffer, Jr., is currently using meristic, morphometric, and allozyme data to describe several new species of *Cottus* throughout the Appalachian Mountains. The frozen specimens will be made available to Dr. Raesly. One fin will be clipped from all minnow species and placed 100% ethanol. This material will be available for future DNA analysis if it is deemed necessary.

All preserved fishes will be placed in permanent storage into The Pennsylvania State University Fish Museum. The data will be presented in both paper and electronic formats. A report will be generated comparing similarities and differences among sites. Stauffer et al. (1995) completed an extensive survey of the fishes of West Virginia. Data collected as part of this study will be compared to this historical database.

Determination of Unique Populations

Fishes in headwater streams often represent peripheral populations. Many times gene flow among these populations and those in higher order streams is restricted. Thus, these areas may harbor fish populations that are unique from those in higher order streams and from those in other regions. The second phase of this project will involve collecting meristic and morphometric data from the specimens collected to characterize the fish communities and comparing these data to populations from higher order streams within and among drainages. Collections of fishes from these higher order streams are currently catalogued into the Pennsylvania State University Fish Museum and were the result of collections made by Stauffer et al. (1995).

External counts and measurements will follow Stauffer (1991; Table 1). Except for gill raker meristics, all counts and measurements will be made on the left side of the fish. Morphometric values will be expressed as percent standard length (SL) or percent head length (HL). We will analyze the data to determine which populations of each species are different from each other. These analyzes will indicate those populations that are phenotypically different from each other.

Morphology has always played an important role in the study of the systematics and evolution of organisms. As part of these studies, attempts have been made to qualify and quantify the shape of the organism. Historically, biological shapes have been delineated by a single measurement or a small number of measurements (Oxnard 1978) that have been standardized by the use of rations(Strauss 1980). The use of ratios is now generally believed to be statistically invalid when delineating among groups (Humphries et al. 1981, Atchley 1978, Bookstein et al. 1985, Reyment et al. 1984, Mosimann and James 1979). Morphological data have been analyzed using principal

component analysis. The first principal component has been regarded as a size component, while the additional components are considered to be dependent on the shape of the individual. This technique has also been questioned because there is an effect of size on components other than the first one. Consequently, a sheared principal components analysis was developed by Humphries et al. (1981), which restricts the variation due to size to the first component; the subsequent components are strictly shape related.

Differences in body shape will be analyzed using sheared principal component analysis of the morphometric data following Stauffer et al. (1997). Pectoral-fin length and pelvic-fin length will not be included in the analysis, as well as any other variables that are influenced by sex and reproductive stage of the fish. Meristic data will be analyzed using principal component analysis. The correlation matrix will be factored in the calculation of all principal component analysis, while the covariance matrix will be factored in the calculation of the sheared principal components. This analysis ordinates factors independently of a main linear ordination (Reyment et al. 1984). Differences among species will be illustrated by plotting either the sheared second or third principal components of the morphometric data against the first principal component of the meristic data. The minimum polygon clusters of each species will be compared to each other. If the mean multivariate scores of the clusters are significantly different along one axis, independent of the other axis, a Duncan's multiple range test ($p<0.05$) will be used to determine which clusters differ from each other. If, in fact, the clusters are not significantly different along one axis independent of the other, then a MANOVA, in conjunction with a Hotelling-Lawley trace will be used to determine whether the mean multivariate scores of the clusters are significantly different ($p<0.05$).

Depending upon the results, we may want to initiate additional genetic or breeding experiments to determine if any observed phenotypic differences are caused by phenotypic plasticity or genetic isolation.

Evaluation of Mining Effects

Data collected to characterize the fish community will be used to analyze the effects of mountain top removal mining and associated valley fills on fish communities downstream from these activities. One way to evaluate the effects of these activities on fish communities is to use an index of biotic integrity (IBI; Karr 1981; Karr and Chu 1999). The IBI was designed to evaluate the integrity of streams using a multimetric index based on the characteristics (e.g., species richness, percent native species) of the resident fish community. Because West Virginia does not currently have a set of metrics developed for an IBI in this region, we will develop an IBI for this region based on data collected during the current study and on historical records from Stauffer et al. (1995) and the West Virginia DNR. All sites will be scored using the multimetric index (IBI) that we develop for this area. Estimates of standing crop will also be used to evaluate potential effects at the sites. To aid us in teasing out the effects of mining from other impacts, we will develop similarity matrices based on the presence or absence of fish species to group similar sites. We will use the attributes collected by EPA at each site to determine what factors are responsible for similarity or dissimilarity.

U.S. Fish and Wildlife Service Funded Study

The Pennsylvania Field Office of the U.S. Fish and Wildlife Service has committed $25,000 to complete a smaller project that is a subset of the entire project. The objectives of the pilot project are to characterize the fish species composition in a subset of the sites designated by the West Virginia EPA and to evaluate the biological integrity of these sites using an IBI. Depending on the site, a stream section at least 40 times the stream width and not to exceed 150m will be selected (Lyons 1992). Sampling will take place in Spring 2000 (late April through May). Fishes will be collected using a single pass of electrofishing, and the majority of fishes will be preserved in 10% formalin and transferred to The Pennsylvania State University Fish Museum for permanent storage in 50% isopropanol. If brook trout (*Salvelinus fontinalis*) are collected, the adipose fin of all trout collected will be clipped and placed in 100% ethanol. Brook trout will be counted, measured (total length, mm), weighed (g), and released. Only 10 brook trout from each collection will be preserved. In addition, where sculpins, *Cottus* spp., are collected, 10 will be frozen on dry ice and transported to the ultra-freezer at Penn State. Dr. R. Raesly, a former Ph.D. student of J. R. Stauffer, Jr., is currently using meristic, morphometric, and allozyme data to describe several new species of *Cottus* throughout the Appalachian Mountains. The frozen specimens will be made available to Dr. Raesly. One fin will be clipped from all minnow species and placed 100% ethanol. This material will be available for future DNA analysis if it is deemed necessary.

All preserved fishes will be placed in permanent storage into The Pennsylvania State University Fish Museum. The data will be presented in both paper and electronic formats. A report will be generated comparing similarities and differences among sites based on the presence/absence of fish species and on the IBI scores and will be available in late June 2000. Stauffer et al. (1995) completed an extensive survey of the fishes of West Virginia. Data collected as part of this study will be compared to this historical database.

LITERATURE CITED

Atchley, W.R. 1978. Ratios, regression intercepts, and the scaling of data. Syst. Zool. 27:78-83.

Bookstein, F., B. Chernoff, R. Elder, J. Humphries, G. Smith, and R. Strauss. 1985. Morphometrics in evolutionary biology. Acad. Natl. Sci. Phila. Spec. Publ. No. 15.

Humphries, J.M., F.L. Bookstein, B. Chernoff, G.R. Smith, R.L. Elder, and S.G. Poss. 1981. Multivariate discrimination by shape in relation to size. Syst. Zool. 30:291-308.

Karr, J.R. 1981. Assessment of biotic integrity using fish communities. Fisheries 6:21-27.

Karr, J.R., and E.W. Chu. 1999. Restoring life in running waters. Island Press, Washington, D.C.

Lyons, J. 1992. The length of stream to sample with a towed electrofishing unit when fish species richness is estimated. North Am. J. of Fish. Manage. 12:198-203.

Mosmimann, J.E. and F. C. James. 1979. New statistical methods for allometry with application to Floridated-winged blackbirds. Evolution 33:444-459.

Oxnard, C.E. 1978. One biologist's view of morphometrics. Ann. Rev. Ecol. Syst. 9:219-241.

Reyment, R.A., R.E. Blackith, and N.A. Campbell. 1984. Multivariate morphometrics (2nd edition). Academic Press, New York.

Stauffer, J.R., Jr. 1991. Description of facultative cleanerfish (Teleostei: Cichlidae) from Lake Malawi, Africa. Copeia 1991:141-147.

Stauffer, J. R., Jr., J. M. Boltz, and L. R. White. 1995. The Fishes of West Virginia. Academy of Natural Sciences of Philadelphia. Philadelphia, Pennsylvania. 389 pp.

Stauffer, J. R., Jr., N. J. Bowers, K.A. Kellogg, and K.R. McKaye. 1997. A revision of the blue-back *Pseudotropheus zebra* (Teleostei: Cichlidae) complex from Lake Malawi, Africa, with a description of a new genus and ten new species. Proc. Acad. Nat. Sci. Phila. 148:189-230.

Strauss, R.E. 1980. Genetic and morphometric variation and the systematic relationship of eastern North American sculpins (Pisces: Cottidae). Ph.D. dissertation, The Pennsylvania State University, University Park, PA.

Van Deventer, J. S. and W. W. Platts. 1983. Sampling and estimating fish populations from streams. Trans. N. Am. Wildl. Natural Res. Conf. 48:349-354.